SUPERIOR BOWEN

November 6, 2018

SMA WITH GTR CONTRACTOR'S PERSPECTIVE

Topics:

Products Used
Terminal Blending
Mix Design
Plant Production
QC Lab & Field
Performance Testing
Summary

Products In Use

Products	• Rubber #30 Mesh • Rubber #50 Mesh – Lehigh MicroDyne MD-400 TR • Vestenamer • Rheopave – 80-Rheopave XP10 • PG64-22

Products

Rheopave™

Lehigh Technologies has partnered with Rheopave Technologies, LLC, to provide the asphalt industry with a cost-conscious additive that boosts the performance of ground tire rubber and MRP in rubber-modified asphalt (RMA) binders. Rheopave™ is a patented blend of polymers and other components developed specifically to network with rubber powders to increase rutting/channeling resistance (an increase in multiple stress creep recovery, or MSCR value), improve storage stability and impart greater mix workability and compaction. RMA systems are longer lasting, less costly, and friendlier to the environment than conventional asphalt systems.

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Products

MicroDyne™

Versatile and Valuable

Lehigh offers MicroDyne™ MRPs in a range of particle sizes—from 830 microns (20 mesh) to 50 microns (300 mesh)—to fit a wide array of applications. Lehigh's customers have deployed MicroDyne™ MRPs in plastics, asphalt, construction, coatings and other applications. MicroDyne™ can be made from tire rubber material, natural rubber, nitrile rubber, butyl rubber or EPDM rubber.

MicroDyne™ MRPs provide a range of benefits:

•Improved performance attributes, such as water resistance, energy savings, durability, flexibility, sound dampening, heat absorption and vibration dampening.

•Significant cost savings over virgin raw materials.

•A sustainable raw material that helps customers achieve corporate goals.

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Terminal Blending

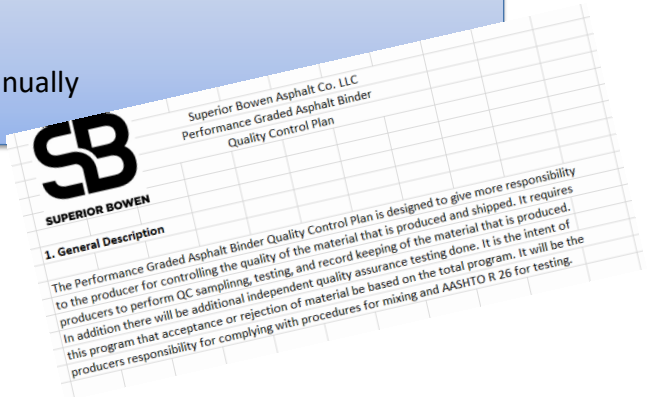
Keys to Successful Blending

HEAT!

Addition Rates:

64V	64H
8-12% Rubber	6-9% Rubber
0.5% Rheopave	0.5% Rheopave

MoDOT requirements:
Terminal Certification
QC Plan
Batches QA verified annually
Daily Oil Samples


Superior Bowen Asphalt Co. LLC
Performance Graded Asphalt Binder
Quality Control Plan

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1. General Description

The Performance Graded Asphalt Binder Quality Control Plan is designed to give more responsibility to the producer for controlling the quality of the material that is produced and shipped. It requires producers to perform QC samplinng, testing, and record keeping of the material that is produced. In addition there will be additional independent quality assurance testing done. It is the intent of this program that acceptance or rejection of material be based on the total program. It will be the producers responsibility for complying with procedures for mixing and AASHTO R 26 for testing.

Construction Materials Testing Group

Performance Graded Asphalt Binder

Certificate of Analysis

ID #: 062217F1

Date Sampled: 6/22/2017 **Date Completed:** 06/23/17

Analyst: AAH **Tank Number:** 3 **State:** MO

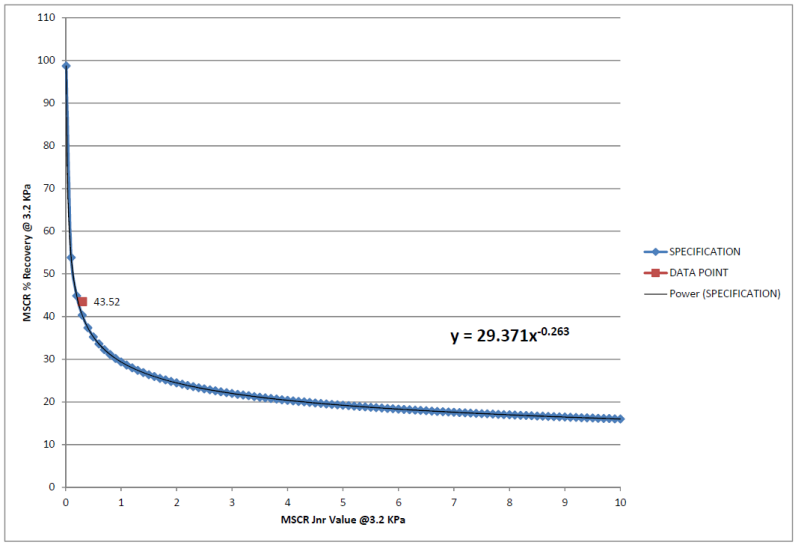
Test Description:	Temp:	Method:	Specification:	Inspection:
Original Binder				
Specific Gravity @ 25°C		AASHTO T228	1 kg/m³	1.0350
Flash Point, COC, °C		AASHTO T48	230 minimum	310
Rotational Viscosity	@ 135 °C	AASHTO T316	3.000 Pa's maximum	1.510
Dynamic Shear Rheometer	@ 64°C	AASHTO T315	1.00 kPa minimum	4.849
Rolling Thin Film Oven (RTFO) Residue, AASHTO T240				
Mass Change	@ 163°C	AASHTO T240	1.0% maximum	-0.17%
Dynamic Shear Rheometer	@ 64°C	AASHTO T315	2.20 kPa minimum	12.107
MSCR	@ 64°C	AASHTO T350	% Rec @ 3.2 KPA	43.52
MSCR	@ 64°C	AASHTO T350	Jnr @ 3.2 KPA	0.305
Pressure Aging Vessel (PAV) Residue, AASHTO R28				
Dynamic Shear Rheometer	@ 25°C	AASHTO T315	5000 kPa maximum	2,115
Creep Stiffness	@ -12°C	AASHTO T313	300 MPa maximum	83
Slope, m-value	@ -12°C	AASHTO T313	0.300 minimum	0.307
Direct Tension		AASHTO T314	1.0% minimum	--

Performance Grade		64V-22	

This document certifies that this material complies with AASHTO M226 and AASHTO M332 specifications for Performance Graded asphalt binder.

Allen Holloway

Certified by Construction Materials Testing Group Authorized Representative



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Mix Design

Gradation Adjustments
Drain Down Concerns
Mineral Filler / Fly Ash
Cellulous Fibers

Aggregate	Bin %
PG64-22 w/ 10% GTR & 0.5% Rheo	6.3%
½" Limestone	38.5%
3/8" Limestone	33.0%
3/8" Chat	15.0%
Drag Sand	9.0%
Mineral Filler	4.5%
Cellulose Fibers	0.3%

Aggregate Requirements

403.2.5 Stone Matrix Asphalt. In addition to other requirements, material for SMA mixtures shall meet the following. Coarse aggregate shall consist of crushed limestone and either porphyry or steel slag in accordance with the quality requirements of Sec 1002, except as follows. The Los Angeles (LA) abrasion, when tested in accordance with AASHTO T 96, shall not exceed 40 percent based on initial ledge approval and source approval. The percent absorption, when tested in accordance with AASHTO T 85, shall not exceed 3.5 percent based on the individual fractions. The amount of flat and elongated particles, measured on material retained on a No. 4 sieve, of the blended aggregate shall not exceed 20 percent based on a 3:1 ratio or 5 percent based on a 5:1 ratio.

Drain down

403.4.9 Draindown. AASHTO T 305, Draindown Test, shall be performed on all SMA mixtures prior to job mix approval. The mixture shall be stabilized in such a way that the draindown of the asphalt binder shall not exceed 0.3 percent by weight of mixture.

Vca

403.4.10 Voids in Coarse Aggregate. The percent VCAMIX of SMA mixtures shall be less than or equal to the VCADRC as determined using AASHTO T 19. This may be calculated using the following equations:

$$VCA_{DRC} = 100 \times (G_{CA}\gamma_w - \gamma_s) / G_{CA}\gamma_w$$

$$VCA_{MIX} = 100 - (P_{bp} \times G_{mb} / G_{CA})$$

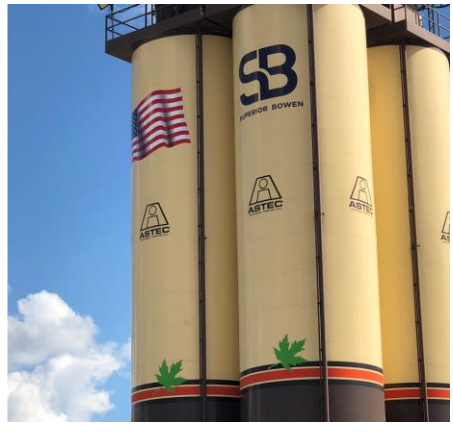
$$P_{bp} = P_s \times PA_{bp}$$

Where: G_{CA} = bulk specific gravity of the combined coarse aggregate (AASHTO T 85),
γ_s = unit weight of coarse aggregate in the dry-rodded condition (DRC) (lb/ft3) (AASHTO T 19),
γ_w = unit weight of water (62.34 lb/ft3) ,
P_{bp} = percent aggregate by total mixture weight retained on No. 4 sieve and
PA_{bp} = percent aggregate by total aggregate weight retained on No. 4 sieve*.

*Use No. 8 sieve for SP095xSM

Plant Production

Oil Calibration
Oil Circulation
Age of Oil
Mixing Temp

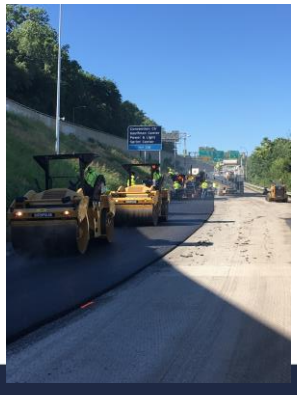


Issues…

QC

Particle Swell
Gradation
Ignition Samples
Compaction
PG Grading / Extraction

403.5.2 Density. The final, in-place density of the mixture shall be 94.5 ± 2.5 percent of the theoretical maximum specific gravity for all mixtures except SMA. SMA mixtures shall have a minimum density of 94.0 percent of the theoretical maximum specific gravity. The theoretical maximum specific gravity shall be determined from a sample representing the material being tested. Tests shall be taken not later than the day following placement of the mixture. The engineer will randomly determine test locations.



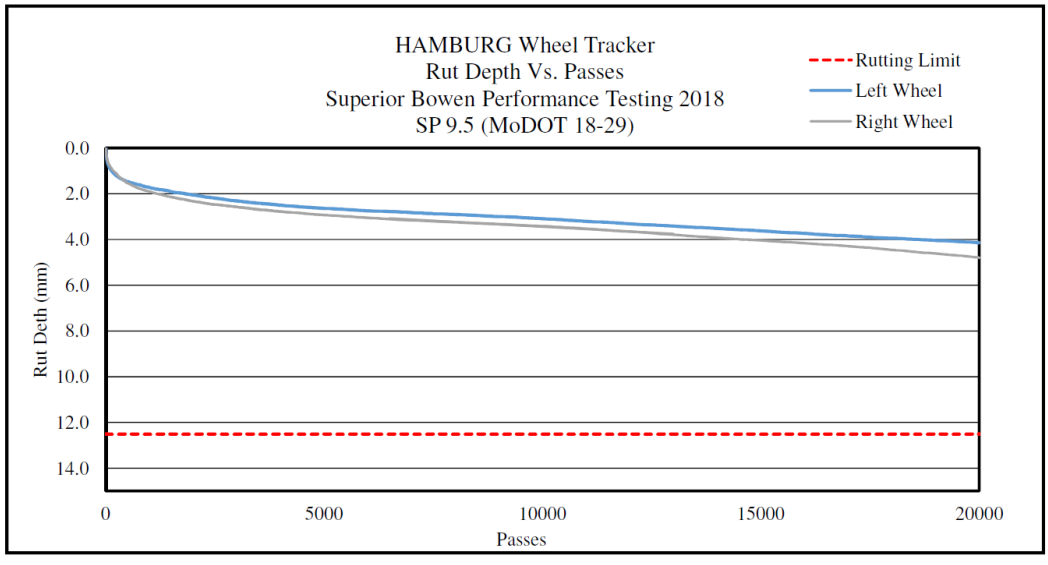
Performance Testing

Hamburg
I-Fit
DCT

Hamburg

CMTG
CONSTRUCTION MATERIALS TESTING GROUP

Date Sampled	07/30/18			
User Name	C. Haahr			
Organization	CMTG			
Project / Mix	Superior Bowen Performance Testing 2018 / SP9.5 MODOT18-29			
Specimen ID:	L-1	L-2	R-1	R-2
Thickness (mm)	65.0	65.0	65.0	65.0
% Air Voids	5.9	6.0	5.8	5.8
RESULTS	Left Wheel		Right Wheel	
Rut Depth Limit (mm)	12.5		12.5	
Target Passes to Failure	20,000		20,000	
Final Rut Depth (mm)	4.14		4.79	
Total Passes	20,000		20,000	
Passes at Failure	20,000		20,000	
Stripping Inflection Point (SIP)	None		None	
Rut Depth at SIP (mm)	N/A		N/A	
Rutting Acceptance (Pass/Fail)	PASS		PASS	

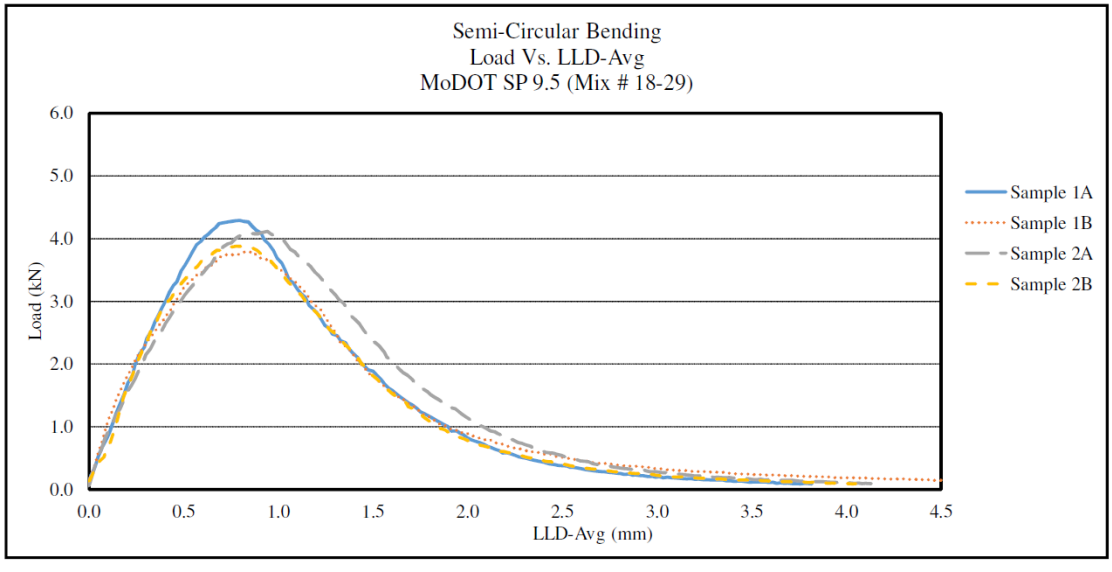


SUPERIOR BOWEN

SCB

CMTG
CONSTRUCTION MATERIALS TESTING GROUP

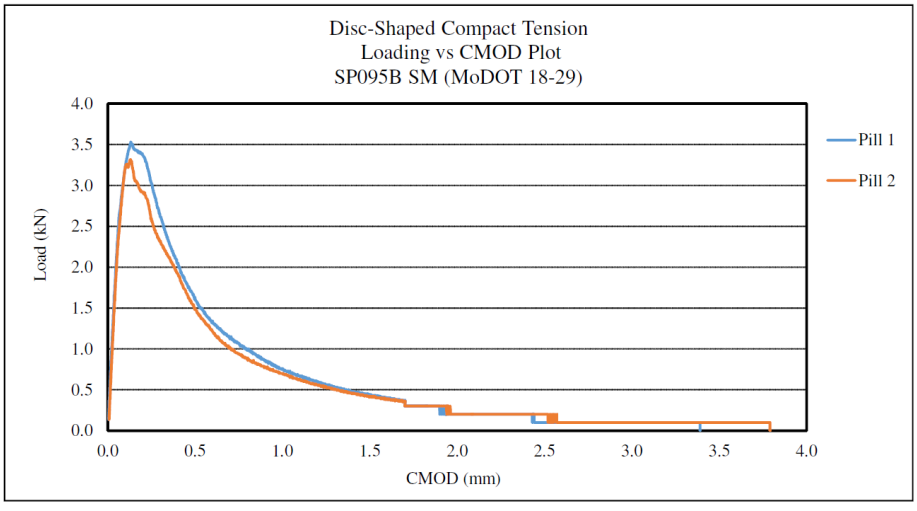
Date Sampled	7/30/2018				
User Name	C. Haahr				
Organization	CMTG				
Mix / Project	SP 9.5 (MoDOT 18-29) / Superior Bowen Performance Testing 2018				
Specimen ID	Pill 1A	Pill 1B	Pill 2A	Pill 2B	
Test Temperature	25 C	25 C	25 C	25 C	
Specific Gravity	2.264	2.264	2.261	2.261	
Air Void Content	5.8	5.8	6	6	
Thickness (mm)	50.5	50	49.5	50.2	
Ligament (mm)	58.4	59.3	58.7	58.8	
Notch Depth (mm)	15.2	15.2	15.1	14.9	
Peak Load (kN)	4.293	3.796	4.117	3.879	
Time to Peak Load	0.992	1.066	1.165	0.967	
Disp at Peak Load	0.796	0.863	0.943	0.778	
Test Duration (seconds)	4.588	6.6216	5.0344	4.8608	**Average**
Fracture Energy (J/m^2)	1870.9	1939.1	2074.8	1802.0	1921.7
Strength (kPa)	577.5	509.5	563.5	524.2	543.7
Slope at Inflection Point	-4.26 k	-3.54 k	-3.59 k	-3.46 k	-3.71 k
Flexibility	4.4	5.5	5.8	5.2	5.2
Secant Stiffness (kN/mm)	5.4	4.4	4.4	5.0	4.8
Critical Displacement (mm)	1.9	2.0	2.2	2.0	2.0



DCT

CMTG
CONSTRUCTION MATERIALS TESTING GROUP

Date Sampled	7/30/2018		
Operator Name	C. Haahr		
Organization	CMTG		
Mix / Project	SP095B SM (MoDOT 18-29) / Superior Bowen Performance Testing 2018		
Specimen ID	Pill 1	Pill 2	Pill 3
Test Temperature	-12 C	-12 C	- - -
Diameter	150.00 mm	150.00 mm	- - -
Thickness	50.58	50.51	- - -
Ligament	82.12	82.43	- - -
Cumulative Area	2479.37 N-mm	2370.84 N-mm	- - -
Actual Test Rate	0.0170 mm/second	0.0170 mm/second	- - -
Disp at Max Load	0.1281 mm	0.1225 mm	- - -
Time at Max Load	7.80 seconds	7.44 seconds	- - -
Ave Chamber Temp	-12.0 C	-12.0 C	- - -
Test Duration	199.88 seconds	223.20 seconds	- - -
Significant Performance Values			
Max Load	3.531 kN	3.317 kN	- - -
Fracture Energy (J/m^2)	597 J/m²	569 J/m²	- - -



Summary

- SMA good field performance with GTR
- GTR production is fairly easy
- Requirements for blending/certifying are low if you have the PG equipment
- Storage capacity can be a challenge
- Time needed for material to react
- Additional stirring capacity

Potential Upgrades:

- Shear pump for the AC
- Quick heater for AC

Contact Info

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